<States and Structures> Electron Microscopy and Crystal Chemistry

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- Electron Microscopy and Crystal Chemistry -

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Prof CEULEMANS, Arnout	University of Leuven, Belgium, 10–11 January 2002
Prof WEGNER, Gerhart	Max-Planck-Institute for Polymer Research, Germany, 1–2 February 2002
Dr LIEBERWIRTH, Ingo	Max-Planck-Institute for Polymer Research, Germany, 2–20 December 2002

Scope of Research

Structures of materials and their structural transition associated with chemical reactions are studied through direct observation of atomic or molecular imaging by high-resolution spectromicroscopic method which realizes high resolution energy-filtered imaging as well as electron energy-loss spectroscopy. It aims to explore new methods for imaging and also obtaining chemical information in thin films, nano-clusters, interfaces, and even in solutions. By combining with scanning probe microscopic methods, the following subjects are studied: direct structure analysis, electron crystallographic analysis, epitaxial growth of molecules, structure formation in solutions, fabrication of low-dimensional functional assemblies.

Research Activities (Year 2002)

Presentations

Electrical properties of $CuPcF_{16}$ films with top and bottom FET electrodes, Minari T *et al*., 49th The Japan Society of Applied Physics., 27 March.

Development of a cold-FEG with a build-up tip for STEM, Kurata H *et al.*, Strategies and Advances in Atomic Level Spectroscopy and Analysis, 9 May.

Quantitative analysis of high resolution TEM images for CaF_2 and BaF_2, Tsujimoto M, Takano H, Ogawa T *et al*., 58th Annual Meeting Elec. Micro., 14 May.

Application of ELNES to local analysis, Kurata H, Hojou K(JAERI), 58th Annual Meeting Elec. Micro., 16 May.

Observation of formation process of metal nano-rod by cryo-TEM, Hayashi M, Ogawa T, Isoda S, 58th Annual Meeting Elec. Micro., 16 May.

High-resolution observation of the surface of M-Phc crystals, Moriguchi S, 58th Annual Meeting Elec. Micro., 16 May.

Fast electron energy-loss spectroscopy on metal phthalocyanines, Koshino M, Kurata H, Isoda S; 2nd Intern. Conf. Porphyrines and Phthaocyanines, 3 July.

Organization of copper-phthalocyanine molecules on a mono-molecular organic layer, Takajo D *et al*., 2nd Intern. Conf. Porphyrines and Phthaocyanines, 2 July.

EELS analysis and DV- Xα calculation for 7,7,8,8-tetracyanoquinodimethane (TCNQ) and tetrafluoro-TCNQ. Koshino M, Kurata H, Isoda S. 15th Annual Meeting Soc. DV-Xα Japan, Jul. 31 - Aug. 2.

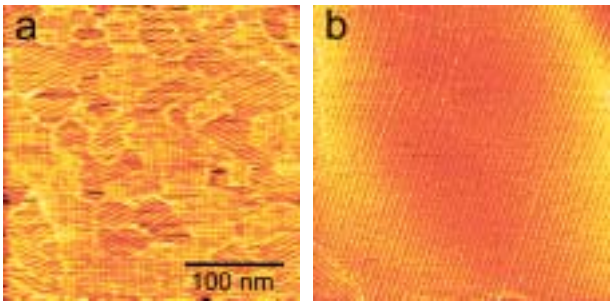
Expeimental estimation of dyanmical scattering effect on electron crystallography, Isoda S, Kuwamto K, Ogawa T, XIX Conference and General Assembly of the Intern. Union of Cryst., 8 August.

Topics

Monolayer and bilayer formation of 17, 19-dotetracontadiyne at a liquid/solid interface

Monolayer and bilayer of 17, 19- dotetracontadiyne (DTDY) on graphite substrate were studied by scanning tunneling microscopy at a liquid/solid interface of phenyloctane solution. The orientation of the layers was examined with respect to the HOPG. The first layer grew very quickly with many small domains with some tens nm in diameter, and the alkyl chains of the molecule in each domain align epitaxially along the a_g-axis of graphite (Fig.a). When the solution keeps at room temperature, the second layer of DTDY became to grow epitaxially on the first layer and the domain size was much larger than that of the first layer (Fig.b).

1. Takajo D, Fujiwara E, Irie S *et al*., J. Cryst. Growth., **237-239**, 2071-2075 (2002).



Formation process of ultra fine platinum particles in an aqueous solution with surfactant

Formation process of ultrafine metal particles in water was examined with a cryogenic transmission electron microscope by using a rapid freezing specimen preparation technique. The particles were formed by hydrogen-reduction in an aqueous solution of chloroplatinic acid with or without a surfactant. The ultrafine platinum particle was obtained with the surfactant, and they were concluded to be formed not in a micelle as a nucleation site, but in arbitrary places in solution. During the formation process, the particles are coated and stabilized by surfactant molecules so as not to aggregate each other, when using the surfactant (Fig.c).

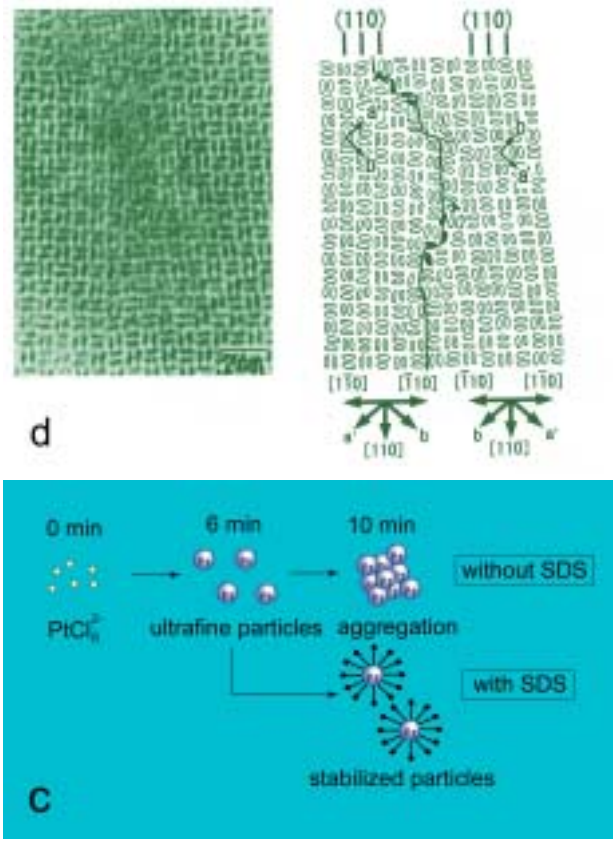
2. Hahakura S, Isoda S, Ogawa T *et al*., J. Cryst. Growth., **237-239**, 1942-1945 (2002).

Epitaxial growth and defect structure of quterrylene studied by high resolution electron microscopy

Vapor deposited epitaxial films of quaterrylene on (001) of KCl were investigated using high-resolution electron microscopy and electron diffraction. The crystal c-axis is parallel and perpendicular to the substrate surface at a lower and at a higher temperature, respectively. This means that the long axis of the quaterrylene molecule is in the film plane at a lower temperature and becomes perpendicular to it at a higher temperature.

High-resolution images revealed the detailed features of an edge dislocation, twin boundaries and small angle grain boundaries (Fig.d). Differing from the normal part of the crystal, the unit cells are deformed and the orientation of molecules are varied from unit cell to unit cell at defects. In addition, solitary molecular columns are seen to occupy empty spaces formed at the dislocation core or at the grain boundaries in order to relax the lattice distortion.

3. Maeda T, Isoda S, Kobayashi T, phys. stat. sol. (a)**191**, 489-498 (2002)



Two-dimensional crystal structures of the first and second layers of stearic acid at liquid/solid interface, Nemoto, T, Takajo D, Isoda S, XIX Congress of the Intern. Union of Cryst., 6 - 15 Aug.

Grants

Isoda S, Nanotechnology Support Project, The Ministry of Education, Science, Culture and Sports, Japan, 1 July 2002 - 31 March 2003.